

Discussion

The GHTI installation of the PT-6-67D in the UH-1H helicopter, at the time of application, was identified as incorporating one and possibly more electrical/electronic systems, such as a FADEC. After the design is finalized, GHTI will provide the FAA with a preliminary hazard analysis that will identify any other critical functions that are performed by the electrical/electronic systems required for safe flight and landing.

Recent advances in technology have given rise to the application in aircraft designs of advanced electrical/electronic systems that perform critical functions. These advanced systems respond to the transient effects of induced electrical current and voltage caused by HIRF incidents on the external surface of the helicopter. These induced transient currents and voltages can degrade the performance of the electrical/electronic systems by damaging the components or by upsetting the systems' functions.

Furthermore, the electromagnetic environment has undergone a transformation not envisioned by the current application of § 29.1309(a). Higher energy levels radiate from operational transmitters currently used for radar, radio, and television. Also, the number of transmitters has increased significantly.

Existing aircraft or alteration certification requirements are inappropriate in view of these technological advances. In addition, the FAA has received reports of some significant safety incidents and accidents involving military aircraft equipped with advanced electrical/electronic systems when they were exposed to electromagnetic radiation.

The combined effects of the technological advances in helicopter design and the changing environment have resulted in an increased level of vulnerability of the electrical/electronic systems required for the continued safe flight and landing of the helicopter. Effective measures to protect these helicopters against the adverse effects of exposure to HIRF will be provided by the design and installation of these systems. The following primary factors contributed to the current conditions: (1) Increased use of sensitive electronics that perform critical functions; (2) reduced electromagnetic shielding afforded helicopter systems by advanced technology airframe materials; (3) adverse service experience of military aircraft using these technologies; and (4) an increase in the number and power of radio frequency

emitters and the expected increase in the future.

The FAA recognizes the need for aircraft certification standards to keep pace with the developments in technology and environment and, in 1986, initiated a high priority program to (1) determine and define electromagnetic energy levels; (2) develop and describe guidance material for design, test, and analysis; and (3) prescribe and promulgate regulatory standards.

The FAA participated with industry and airworthiness authorities of other countries to develop internationally recognized standards for certification.

The FAA and airworthiness authorities of other countries have identified a level of HIRF environment that a helicopter could be exposed to during visual flight rules (VFR) operations. While the HIRF rulemaking requirements are being finalized, the FAA is adopting a special condition for the certification of aircraft that employ electrical/electronic systems that perform critical functions. The accepted maximum energy levels that civilian helicopter system installations must withstand for safe operation are based on surveys and analysis of existing radio frequency emitters. This special condition will require the engine installation's electrical/electronic systems and associated wiring to be protected from these energy levels. These external threat levels are believed to represent the worst-case exposure for a helicopter operating under VFR conditions.

These special conditions will require the systems that perform critical functions, as installed in the aircraft, meet certain standards based on either a defined HIRF environment or a fixed value using laboratory tests.

The applicant may demonstrate that the operation and operational capabilities of the installed electrical/electronic systems that perform critical functions are not adversely affected when the aircraft is exposed to the defined HIRF test environment. The FAA has determined that the test environment defined in Table 1 is acceptable for critical functions in helicopters.

The applicant may also demonstrate by a laboratory test that the electrical/electronic systems that perform critical functions can withstand a peak electromagnetic field strength in a frequency range of 10 KHz to 18 GHz. If a laboratory test is used to show compliance with the defined HIRF environment, no credit will be given for signal attenuation due to installation. A level of 100 volts per meter (v/m) and

other considerations, such as alternate or backup technology that is immune to HIRF, are appropriate for critical functions during instrument flight rules (IFR) operations. A level of 200 v/m is more appropriate for critical functions during VFR operations. Laboratory test levels are defined according to RTCA/DO-160D Section 20 Category W (100 v/m and 150 mA) and Category Y (200 v/m and 300 mA). As defined in DO-160D Section 20, the test levels are defined as the peak of the root means squared (rms) envelope. As a minimum, the modulations required for RTCA/DO-160D Section 20 Categories W and Y will be used. Other modulations should be selected as the signal most likely to disrupt the operation of the system under test, based on its design characteristics. For example, flight control systems may be susceptible to 3 Hz square wave modulation while the video signals for electronic display systems may be susceptible to 400 Hz sinusoidal modulation. If the worst-case modulation is unknown or cannot be determined, default modulations may be used. Suggested default values are a 1 KHz sine wave with 80 percent depth of modulation in the frequency range from 10 KHz to 400 MHz and 1 KHz square wave with greater than 90 percent depth of modulation from 400 MHz to 18 GHz. For frequencies where the unmodulated signal would cause deviations from normal operation, several different modulating signals with various waveforms and frequencies should be applied.

Applicants must perform a preliminary hazard analysis to identify electrical/electronic systems that perform critical functions. The term "critical" means those functions whose failure would contribute to or cause an unsafe condition that would prevent the continued safe flight and landing of the helicopter. The systems identified by the hazard analysis as performing critical functions are required to have HIRF protection.

A system may perform both critical and noncritical functions. Primary electronic flight display systems and their associated components perform critical functions such as attitude, altitude, and airspeed indications. HIRF requirements would apply only to the systems that perform critical functions.

Compliance with HIRF requirements will be demonstrated by tests, analysis models, similarity with existing systems, or a combination of these methods. The two basic options of either testing the rotorcraft to the defined environment or laboratory testing may not be combined. The laboratory test allows some frequency